PB-239 575

COKATO LAKE, WRIGHT COUNTY, MINNESOTA

Pacific Northwest Environmental
Research Laboratory

Prepared for:

National Environmental Research Center
Minnesota National Guard
Minnesota Pollution Control Agency

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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CONTENTS

	Page
Foreword	ii
List of Minnesota Study Lakes	iv, v
Lake and Drainage Area Map	vi
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	3
III. Lake Water Quality Summary	4
IV. Nutrient Loadings	8
V. Literature Reviewed	13
VI. Appendices	14

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

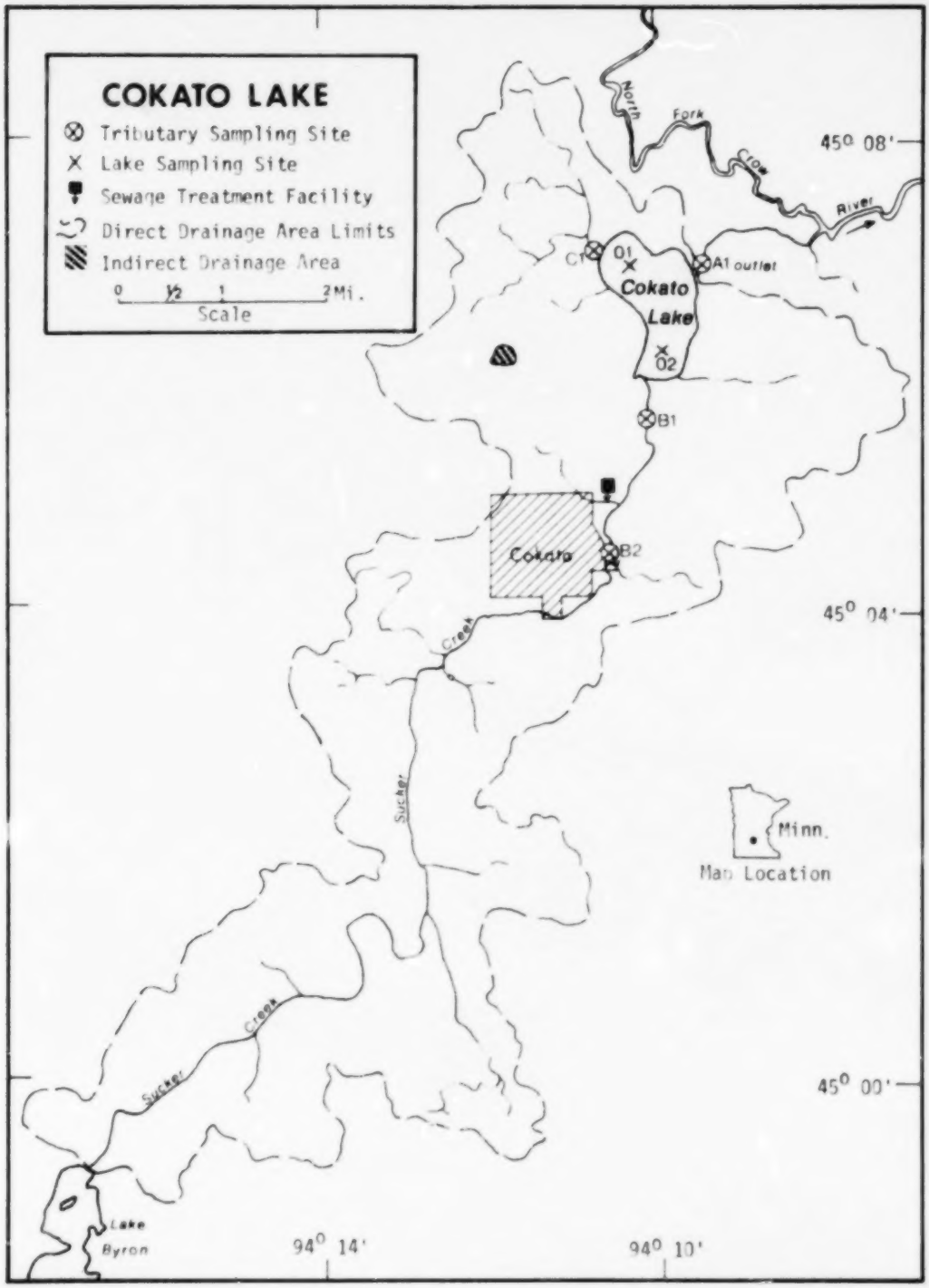
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


COKATO LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Direct Drainage Area Limits
Indirect Drainage Area
0 ½ 1 2 Mi.
Scale
North Fork Crow River
45° 08'
C1
O1
A1 outlet
Cokato Lake
O2
B1
Cokato
B2
45° 04'
Creek
Sucker
Minn.
Map Location
Sucker Creek
45° 00'
Lake Byron
94° 14'
94° 10'

COKATO LAKE

STORET NO. 2719

I. CONCLUSIONS

A. Trophic Condition:

Survey data and the records of others show that Cokato Lake is eutrophic. Of the 60 Minnesota lakes sampled in the fall when essentially all were well-mixed, only 3 had poorer overall water quality based on the parameters measured during the Survey.

Survey limnologists noted a heavy algal bloom in progress in June, and marked oxygen depression with depth was observed at both lake stations in June and August, 1972.

Reportedly, severe and toxic blooms of blue-green algae have occurred in Cokato Lake in the past (Beaton and McGuire, 1969).

B. Rate-Limiting Nutrient:

Because of a significant loss of phosphorus in the algal assay sample, the results are not reliable.

Lake data indicate nitrogen limitation at all sampling times; i.e., N/P ratios were 4/1 or less.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Cokato Lake received a total phosphorus load at a rate about 5 times that proposed by Vollenweider (in press) as dangerous (i.e., a eutrophic rate; see page 12). Of that load, the Village of Cokato contributed about 27%.

On the basis of Survey data, it does not appear that even complete removal of phosphorus at the Cokato STP would result in a satisfactory trophic condition in Cokato Lake, although the severity and frequency of blue-green algae blooms probably would be reduced. It is calculated that complete removal of phosphorus at the STP would reduce the existing loading rate of 23 lbs/acre/yr (2.6 $g/m^2/yr$) to about 17 lbs/acre/yr or 1.9 $g/m^2/yr$. This rate would still be over 3½ times the dangerous rate.

2. Non-point sources--Attention is called to the high mean non-point phosphorus load of Sucker Creek for the sampling year (as compared to the unnamed stream and Whitewater Creek--tributary to Sakatah Lake in LeSeur County; see page 12). This strongly indicates that there was an unknown point source in the drainage that contributed over 6,600 lbs of phosphorus during the sampling year. If such a source exists and phosphorus can be controlled, it appears that phosphorus control at the Cokato STP would result in the enhancement of the trophic condition of Cokato Lake.

With the reservation noted above, in all, it is estimated that non-point sources contributed about 73% of the total phosphorus load reaching Cokato Lake during the sampling year.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 544 acres.
2. Mean depth: 25 feet.
3. Maximum depth: 50+ feet.
4. Volume: 13,600 acre/feet.
5. Mean hydraulic retention time: 413 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Sucker Creek	32.4 mi^2	12.1 cfs
Unnamed Stream (C-1)	5.3 mi^2	1.7 cfs
Minor tributaries & immediate drainage -	6.4 mi^2	2.8 cfs
Totals	44.1 mi^2	16.6 cfs

2. Outlet -

Sucker Creek	45.0 mi^2**	16.6 cfs

C. Precipitation***:

1. Year of sampling: 24.3 inches.
2. Mean annual: 25.9 inches.

† DNR lake survey map (1964); mean depth by random-dot method.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Cokato Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page vi). During each visit a single depth-integrated (15 feet to surface) sample was composited from the two stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analyses. The maximum depths sampled were 30 feet at station 1 and 27 feet at station 2.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/26/72)		
Temperature (Cent.)	7.5	7.8	7.8	7.9
Dissolved oxygen (mg/l)	9.6	9.7	9.7	9.8
Conductivity (μmhos)	550	553	550	570
pH (units)	8.1	8.2	8.2	8.3
Alkalinity (mg/l)	260	265	260	280
Total P (mg/l)	0.274	0.277	0.275	0.283
Dissolved P (mg/l)	0.261	0.266	0.266	0.270
$NO_2 + NO_3$ (mg/l)	0.410	0.417	0.420	0.420
Ammonia (mg/l)	0.770	0.791	0.790	0.830
		ALL VALUES		
Secchi disc (inches)	28	74	84	108

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/30/72	1. Anabaena	4,991
	2. Melosira	127
	3. Mallomonas	36
	Other genera	18
	Total	5,172
08/29/72	1. Cyclotella	30
	2. Anabaena	19
	3. Cryptomonas	10
	4. Pinnularia	8
	5. Flagellates	7
	Other genera	48
	Total	122
10/26/72	1. Flagellates	1,566
	2. Chroococcus	837
	3. Melosira	837
	4. Anabaena	723
	5. Cyclotella	512
	Other genera	4,475
	Total	6,566

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/30/72	01	17.1
	02	32.8
08/29/72	01	0.5
	02	0.5
10/26/72	01	7.3
	02	5.8

C. Limiting Nutrient Study:

There was a loss of 36% of the dissolved phosphorus in the algal assay sample from the time of collection to the beginning of the assay. Consequently, the assay results are not reliable.

The lake data indicate nitrogen limitation at all sampling times. The N/P ratios were 4/1 or less, and nitrogen limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, from October, 1972, through September, 1973, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May, when two samples were collected, and in January when one site was omitted because of low flow.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the nutrient loads, in $lbs/mi^2/year$, in the unnamed stream at station C-1 and multiplying by the ZZ area in mi^2.

The operator of the Cokato wastewater treatment plant provided modified composite effluent samples and corresponding flow data on a monthly basis. In the following loading tables, the loads attributed to Sucker Creek at station B-1 are those measured minus the Cokato STP loads.

* See Working Paper No. 1.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Cokato	1,735*	act. sludge	0.264	Sucker Creek to Cokato Lake

2. Known industrial - None

* 1970 Census.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Sucker Creek	7,620	60.4
Unnamed stream (C-1)	670	5.3
b. Minor tributaries & immediate drainage (non-point load) -	800	6.3
c. Known municipal -		
Cokato	3,420	27.1
d. Septic tanks* -	20	0.2
e. Known industrial - None	-	-
f. Direct precipitation** -	80	0.6
Total	12,610	100.0

2. Outputs -

Lake outlet - Sucker Creek 7,060

3. Net annual P accumulation - 5,550 pounds

* Estimated 25 dwellings and 1 resort on lakeshore; see Working Paper No. 1.

** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Sucker Creek	80,420	60.5
Unnamed Stream (C-1)	15,500	11.7
b. Minor tributaries & immediate drainage (non-point load) -	18,720	14.1
c. Known municipal -		
Cokato	12,120	9.1
d. Septic tanks* -	820	0.6
e. Known industrial - None	-	-
f. Direct precipitation** -	5,240	3.9
Total	132,820	100.0

2. Outputs -

Lake outlet - Sucker Creek 88,870

3. Net annual N accumulation - 43,950 pounds

* Estimated 25 dwellings and 1 resort on lakeshore; see Working Paper No. 1.

** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs $P/mi^2/yr$	lbs $N/mi^2/yr$
Sucker Creek	235	2,482
Unnamed Stream (C-1)	126	2,924
SAKATAH LAKE:		
Whitewater Creek	130	2,960

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Units	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
lbs/acre/yr	23.2	10.2	244.2	80.8
grams/m^2/yr	2.60	1.14	27.4	9.1

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Cokato Lake:

"Dangerous" (eutrophic rate)	0.52
"Permissible" (oligotrophic rate)	0.26

V. LITERATURE REVIEWED

Anonymous, 1973. Wastewater disposal facilities inventory. MPCA, Minneapolis.

Beaton, Perry T., and John F. McGuire, 1969. Report on investigation of the water quality of Cokato Lake, Wright County. MPCA, Minneapolis.

Schilling, Joel, 1974. Personal communication (lake map; industrial waste sources). MPCA, Minneapolis.

Vollenweider, Richard A., (in press). Input-output models. Schweiz. A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2719 [illegible] LAKE

TOTAL DRAINAGE AREA OF LAKE 45.00

TRIBUTARY	SUBDRAINAGE AREA	JAN	FEB	MAR	APR	MAY	JUN	NORMALIZED FLOWS JUL	AUG	SEP	OCT	NOV	DEC	MEAN
271931	45.00	[illegible]	[illegible]	[illegible]	27.50	38.80	42.80	26.40	12.50	14.30	6.90	5.30	5.30	16.60
271941	32.63	[illegible]	[illegible]	7.77	19.90	24.20	31.10	19.60	8.43	10.50	4.95	3.77	3.95	12.07
271951	5.35	[illegible]	[illegible]	[illegible]	2.07	4.24	5.20	2.44	1.09	1.65	0.62	0.42	0.38	1.73
271977	7.26	1.77	[illegible]	1.75	[illegible]	6.32	7.11	4.44	1.47	2.71	1.14	0.81	1.00	2.81

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 45.00
SUM OF SUBDRAINAGE AREAS = 44.94

TOTAL FLOW IN = 198.87
TOTAL FLOW OUT = 198.70

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
271931	10	72	14.[illegible]	14	14.00				
	11	72	23.13	18	27.00				
	12	72	15.60	2	14.00				
	1	73	15.43	13	11.00	26	11.00		
	2	73	[illegible]	3	11.00				
	3	73	41.13	1[illegible]	25.33				
	4	73	[illegible]	2	57.00	14	50.00		
	5	73	43.15	2	40.00	19	40.00		
	6	73	28.13	2	45.00				
	7	73	7.[illegible]	15	5.43				
	8	73	[illegible]	26	11.00				
	9	73	7.[illegible]						
271941	10	72	11.[illegible]	14	11.00				
	11	72	13.40	18	16.00				
	12	72	[illegible]	2	11.00				
	1	73	3.61	13	2.60	26	2.60		
	2	73	3.74	3	3.10				
	3	73	3.65	15	2.60				
	4	73	35.[illegible]	2	46.00	14	36.00		
	5	73	31.[illegible]	2	34.00	19	24.00		
	6	73	2[illegible]	2	33.00				
	7	73	[illegible]	15	[illegible]				
	8	73	[illegible]	26	7.[illegible]				
	9	73	[illegible]	15	[illegible]				

LAKE CODE 2719 COMATO LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
271901	10	72	1.53	14	1.70				
	11	72	1.83	18	2.20				
	12	72	1.34	2	1.30				
	1	73	0.53	13	0.50	20	0.50		
	2	73	0.44	3	0.50				
	3	73	3.32	16	2.00				
	4	73	5.25	2	6.00	14	5.30		
	5	73	4.55	2	5.20	19	4.30		
	6	73	3.34	2	5.50				
	7	73	0.37	15	0.36				
	8	73	0.34	26	0.44				
	9	73	0.36	16	0.35				
271927	10	72	3.10	14	3.10				
	11	72	3.50	18	4.10				
	12	72	2.28	2	3.40				
	1	73	2.74	13	1.90	20	1.90		
	2	73	1.53	3	1.70				
	3	73	6.91	10	4.20				
	4	73	7.17	2	8.20	14	7.20		
	5	73	6.45	2	7.70	19	6.40		
	6	73	4.62	2	7.60				
	7	73	1.30	15	0.90				
	8	73	1.52	26	1.70				
	9	73	1.41	16	1.40				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

271901
45 06 57.0 094 10 18.0
COKATO LAKE
27 MINNESOTA

11EPALES 2111202
3 0033 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CONDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/30	19 45	0000	24.0	16.8	30	450	8.40	173	0.110	0.050	0.038	0.026
	19 45	0015	17.[illegible]	7.8		526	8.00	202	0.720	0.170	0.053	0.051
	19 45	0030	16.0	[illegible].4		600	7.30	250	0.250	0.850	0.432	0.406
72/08/29	10 20	0000			108	520	8.10	210	0.400	0.370	0.093	0.058
	10 20	0004	21.5	7.8		510	8.10	206	0.400	0.350	0.142	0.136
	10 20	0015	18.2	6.0		530	7.95	216	0.530	0.450	0.157	0.151
	10 20	0022	16.7	1.8		530	7.60	204	0.420	0.700	0.221	0.213
	10 20	0030	11.1	[illegible].0		640	7.45	254	0.090	0.020	1.120	1.000
72/10/26	10 00	0000			84	550	8.10	270	0.420	0.830	0.274	0.269
	10 00	0004	7.9	9.8		550	8.20	260	0.410	0.770	0.278	0.268
	10 00	0015	7.[illegible]	9.7		550	8.20	260	0.410	0.800	0.274	0.264
	10 00	0021	7.9	9.6		550	8.20	260	0.420	0.770	0.274	0.265

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLORPHYL A UG/L
72/06/30	19 45	0000	17.1[illegible]
72/08/29	10 20	0000	0.5[illegible]
72/10/26	10 00	0000	7.3[illegible]

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

271902
45 06 15.0 094 09 57.0
COKATO LAKE
27 MINNESOTA

11EPALES 2111202
3 0027 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/30	20 15	0000	25.0	16.8	28	425	8.40	166	0.060	0.050	0.042	0.024
	20 15	0015	17.0	6.2		530	7.80	206	0.900	0.220	0.065	0.061
	20 15	0027	11.2	0.3		600	7.10	238	0.710	0.680	0.241	0.237
72/08/29	10 45	0000			108	510	8.10	188	0.390	0.380	0.152	0.079
	10 45	0004	20.4	7.0		505	8.10	210	0.400	0.370	0.147	0.075
	10 45	0015	18.8	5.2		535	7.91	226	0.480	0.420	0.105	0.089
	10 45	0020	17.9	3.6		535	7.75	224	0.490	0.560	0.200	0.187
	10 45	0025	14.5	0.8		600	7.55	216	0.110	0.025	0.258	0.223
72/10/26	10 20	0000			84	550	8.30	280	0.420	0.790	0.276	0.266
	10 20	0004	7.9	4.6		550	8.30	270	0.420	0.780	0.283	0.270
	10 20	0015	7.7	4.8		550	8.30	260	0.420	0.800	0.282	0.266
	10 20	0024	7.5	4.8		570	8.30	260	0.420	0.790	0.275	0.261

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/30	20 15	0000	12.8J
72/08/29	10 45	0000	0.5J
72/10/26	10 20	0000	5.2J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/12/10

271941 LS271941
45 07 00.0 094 09 30.0
UNNAMED OUTLET LK/N FK CROW RIVE
27 15 COKATO
U/COKATO LAKE
XING NE CORNER OF LK 3 MI NNE OF COKATO
11FPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00530 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	15 00		1.544	1.775	0.357	0.088	0.230
72/11/15	08 10		[illegible]	1.760	0.490	0.210	0.240
72/12/02	08 35		0.790	2.640	0.465	0.210	0.250
73/01/13	08 20		1.142	2.600	0.430	0.160	0.350
73/02/03	08 20		1.253	1.500	0.147	0.189	0.225
73/03/10	08 00		1.440	3.600	0.610	0.280	0.410
73/04/02	08 30		1.403	2.000	0.070	0.160	0.210
73/04/14	08 40		1.106	2.200	0.026	0.046	0.190
73/05/02	08 25		0.820	1.570	0.120	0.050	0.100
73/05/14	08 10		0.440	1.520	0.110	0.052	0.100
73/06/02	08 45		0.623	1.400	0.056	0.050	0.150
73/07/15	08 40		0.011	1.590	0.130	0.031	0.120
73/08/26	08 25		0.055	1.430	0.580	0.115	0.165
73/09/16	08 35		0.052	1.760	0.400	0.198	0.250

STORET RETRIEVAL DATE 74/10/30

2719H1 LS2719B1
45 05 30.0 094 10 00.0
SUCKER CREEK
27 15 COKATO
I/COKATO LAKE
XING 1 MI NNE OF COKATO BELO STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	15 30		1.040	1.700	0.320	0.168	0.313
72/11/18	07 45		0.970	1.800	0.370	0.092	0.210
72/12/02	08 20		1.800	2.250	0.540	0.110	0.277
73/01/13	08 00		1.160	2.310	0.890	0.160	0.355
73/02/03	08 00		0.960	2.500	1.020	0.132	0.340
73/03/10	07 20		1.360	5.700	1.680	0.300	0.550
73/04/02	08 15		0.930	2.300	0.185	0.078	0.175
73/04/14	08 20		0.870	1.680	0.280	0.069	0.200
73/05/02	08 15		1.460	2.300	0.147	0.084	0.195
73/05/19	08 20		0.930	2.800	0.160	0.180	0.440
73/06/02	08 30		1.000	2.900	0.189	0.220	0.430
73/07/15	08 00		0.120	3.600	0.030	0.220	1.100
73/08/26	08 00		0.580	0.920	0.405	0.490	0.640
73/09/16	08 00		0.010K	10.000	3.400	1.040	1.570

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/10

271982 LS271982
45 04 30.0 094 10 30.0
SUCKER CREEK
27 15 COKATO
1/COKATO LAKE
US 12 XING E OF COKATO ABOVSTP
11FPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO3&NO2 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	15 15		[illegible]	2.[illegible]	0.370	0.048	0.210
72/11/18	07 30		[illegible]	2.500	0.310	0.050	0.150
72/12/02	08 00		2.120	2.323	0.490	0.048	0.160
73/01/13	08 45		[illegible]	1.760	0.700	0.048	0.170
73/02/03	07 45		0.932	1.480	0.700	0.054	0.190
73/03/10	07 30		1.420	4.400	1.790	0.315	0.560
73/04/02	08 00		0.865	1.400	0.060	0.054	0.120
73/04/14	08 00		0.460	3.360	0.190	0.046	0.140
73/05/02	08 00		1.451	1.080	0.044	0.075	0.145
73/05/14	08 00		2.021	1.560	0.010	0.063	0.400
73/06/02	08 00		0.720	2.900	0.094	0.190	0.390
73/07/15	08 15		1.440	1.320	0.270	0.357	0.540
73/08/26	07 45		0.054	0.700	0.230	0.390	0.460
73/09/15	08 20		0.0175	1.350	0.026	0.535	0.935

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

2719C1 LS2719C1
45 07 00.0 094 11 00.0
UNNAMED TRIB TO LK FROM NW
27 15 COKATO
T/COKATO LAKE
XING AT NW CORNER OF LK
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	16 00		2.300	3.200	0.160	0.100	0.273
72/11/11	08 25		1.170	2.600	0.015	0.058	0.105
72/12/02	08 55		4.400	1.900	0.189	0.056	0.130
73/02/03	08 40		1.460	1.700	0.320	0.069	0.180
73/03/10	07 40		2.800	4.900	0.660	0.260	0.410
73/04/02	08 40		3.000	3.120	0.115	0.046	0.145
73/04/14	10 35		2.500	4.600	0.140	0.042	0.185
73/05/02	09 10		2.900	2.400	0.052	0.048	0.097
73/05/19	08 45		1.160	1.470	0.080	0.048	0.110
73/06/02	09 00		3.100	2.800	0.160	0.120	0.250
73/07/15	09 10		0.790	1.200	0.265	0.085	0.135
73/08/26	08 40		0.720	1.900	0.315	0.079	0.370
73/09/16	09 00		0.470	1.680	0.315	0.120	0.230

STORET RETRIEVAL DATE 74/10/30

271951 AS271951 P001735
45 05 00.0 093 10 30.0
CORATO
27 15 CORATO
T/CORATO LAKE
SUCKER CREEK
11EPALES
4 2141204
0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/01/17	11 00								
CP(T)-			12.000	0.750	0.340	3.900	5.200	0.234	0.215
73/01/17	13 00								
73/02/16	11 00								
CP(T)-			12.400	14.000	3.000	4.200	6.500	0.191	0.207
73/02/16	13 00								
73/03/16	11 00								
CP(T)-			2.600	13.600	1.380	2.100	3.400	0.400	0.270
73/03/16	13 00								
73/04/18	11 00								
CP(T)-			2.800	10.500	0.200	2.200	2.900	0.264	0.352
73/04/18	13 00								
73/05/18	11 00								
CP(T)-			10.500	6.500	0.270	2.400	3.300	0.252	0.295
73/05/18	13 00								
73/06/18	11 00								
CP(T)-			4.500	13.900	0.054	3.200	4.000	0.317	0.309
73/06/18	13 00								
73/07/18	11 00								
CP(T)-			0.860	12.000	2.200	3.570	4.500	0.185	0.222
73/07/18	13 00								
73/08/21	11 00								
CP(T)-			0.370	4.100	0.082	4.320	4.550	0.206	0.201
73/08/21	13 00								
73/09/19	11 00								
CP(T)-			1.030	4.300	0.025	4.500	4.800	0.190	0.220
73/09/19	13 00								
73/10/18	11 00								
CP(T)-			5.730	2.600	0.160	1.800	1.950	0.372	0.319
73/10/18	13 00								
73/11/19	11 00								
CP(T)-			8.500	11.500	1.800	2.500	6.500	0.223	0.262
73/11/19	13 00								
73/12/18	11 00								
CP(T)-			7.000	8.700	0.260	2.000	5.600	0.244	0.294
73/12/18	13 00								

STORET RETRIEVAL DATE 74/10/30

271951 AS271951 P001735
45 05 00.0 093 10 30.0
COKATO
27 15 COKATO
T/COKATO LAKE
SUCKER CREEK
LIFRALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/01/18 11 00 CP(T)- 74/01/18 13 10			5.700	20.000	2.700	4.300	5.000	0.212	0.226